

## Chapter 20

### Introduction: Design considerations for live coral exhibits

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#### ABSTRACT

The aim of this session is to bring together aquarists and designers for an open dialogue on what parameters need to be considered when designing exhibits for live corals. All too often, live coral exhibits are an afterthought in the overall aquarium design process. In most cases, architects and designers have predetermined the shape and location of exhibits long before anyone with actual husbandry experience is brought on board. This paper examines issues such as working within a design team, life support system considerations, exhibit design problems with respect to aquascaping, view panels, exhibit size and shape, the use of backdrops and coral placement.

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#### INTRODUCTION

Designing a coral reef exhibit is one of the most challenging and rewarding aspects of being an aquarist. As with other exhibits that house fish, birds, plants, reptiles or marine mammals, consideration needs to be given to not only the mechanical aspects of the system but also the aesthetics. Unfortunately, all too often these aspects of the exhibit design process are in the hands of architects and exhibit designers, many of whom have little or no actual experience as aquarists, and commonly little or no experience with living coral reefs. To be fair, it should be mentioned that there are several excellent exhibit designers, life support system designers and architects that do work with aquarists, who do listen to aquarist concerns, and do truly appreciate aquarist input. However, this is not always the case and one is often left with an exhibit design that really is not suitable for the recreation of a living coral reef. Yet one must still find a way to make it work.

On the flip side of this equation is the aquarist. When faced with the task of aquascaping and maintaining a live coral exhibit, there are often design choices, specimen placement questions, plumbing and other issues that are left to the aquarist to implement. In these cases, it is not unusual to see certain elements that

show evidence of a lack of attention to detail. It is this inattention to detail that separates the truly great exhibits from the merely good exhibits. The goal of a coral reef exhibit should be to suspend disbelief in visitors and give the impression of actually looking into a slice of a living coral reef; visible life support elements and support structures, stained walls and dirty windows shatter this illusion.

#### WORKING WITHIN A DESIGN TEAM

As was mentioned, all too often coral reef exhibits are designed by an architect or exhibit design company that has little experience with coral reefs and/or coral systems. In addition, there is usually little consideration given to aquarist access, lighting and life support system needs and space requirements. Finally, the so-called design-build paradigm sometimes ends up being a build-design process as timelines shrink, budget overruns occur and value engineering comes into play.

The solution to these problems is clear, design and architectural firms must bring on either a consultant experienced with coral reef ecosystems and live coral displays, and

or involve aquarium staff from the absolute beginning of the design phase. Doing so underscores the need for a design specific to the specialized needs of live coral systems. In addition, realistic budgets and expectations need to be created and one must try to resist the "compromise" process that all too often rears its head as cost overruns mount and deadlines loom.

Of course it is well known that the process outlined above is the ideal, the question remains, how does one ensure this happens? The only way to achieve this is if the aquarist, curator, director and the in-house exhibit design team are all on the same page, and that expectations are clearly stipulated to and agreed upon by the exhibit/architecture firm. Problems will arise, and obstacles will be faced, but one has to remain true to one's vision and not bend to compromise when at all possible.

### **CORAL EXHIBIT DESIGN CONSIDERATIONS**

There are several issues that come into play when designing a coral reef exhibit, and many of these will be addressed during this session. Aquascaping, lines of sight, viewing pane shape/size, aquarist access, water motion, lighting and backgrounds, are all issues that need to be well thought out before construction begins.

### **AQUASCAPING**

The underwater landscape of a coral reef is highly variable, comprising steep vertical walls, gradual slopes, spur and groove formations, sandy lagoons or high-energy surge zones. This variability provides a great amount of leeway when it comes to aquascaping an exhibit. Unfortunately, the most commonly seen aquarium aquascapes consist of solid rock walls, studded with corals, either real or artificial. Given the huge amount of aquascape variability that occurs on a natural reef, it is surprising that this aquascape is so commonly represented in aquaria. Exhibit designers are urged to explore the options available and put a greater emphasis on creating variability in rockwork height, shape, texture, porosity and incorporate crevices, grooves, small caves

etc. with greater frequency than is currently seen. However, the aquascape used is truly a reflection of the size and shape of the exhibit. Avoid tall, narrow exhibits whenever possible, they just do not work well for a live coral exhibit, as will be discussed shortly.

In large exhibits with multiple viewing panes, rockwork is essential for blocking sight lines so that other visitors and viewing windows or tunnels are not visible to each other. The aquascape can also be used to create areas of high and low water motion, to control where waves may break or channels of fast moving water are created.

For older coral exhibits, creating adequate water motion is one of the greatest challenges in maintaining coral health. Least one forget, coral does grow (hopefully!) and this must be taken into consideration when designing water flow and motion within the tank. In the live coral systems of today, both private and public, rapid growth of coral has led to problems with water flow and subsequently animal health, necessitating either increases in water motion, aggressive coral pruning or a combination of the two. Coral growth should also be taken into consideration when determining how much rockwork will be in the tank compared to the percentage of open space available. An exhibit filled with rockwork leaves little room for coral to grow before it totally occludes the tank and makes maintenance difficult. Rockwork should allow for the maximum growth space possible to allow corals to attain an impressive, naturalistic size; within limits of course.

Rockwork also functions to conceal plumbing and support structures. Careful attention should be given to rockwork design to ensure that overflows, water inlets and outlets are concealed from view. In addition, rock support structures should also be totally concealed, especially when live rock is used to aquascape the exhibit. No life support system (LSS) components should be visible in the exhibit: no plumbing lines, airlines, airstones, powerheads, pump returns, cleaning magnets, etc. should be visible from any of the viewing panes; nothing mares an exhibit more than having a powerhead or pump outlet visible in a tank. Using the refractive properties of acrylic panels, rockwork edges, side walls and plumbing in the window corners can all be hidden from view.

Finally, aquarist access to the exhibit must also be incorporated into the rockwork design so that there is easy access to all viewing panes for cleaning, and for entry and exit into the tank by divers; these access points should not be visible to the public.

### VIEWING PANELS

The shape of viewing panels also plays an important role in exhibit design and maintenance. Curved surfaces, while they may be architecturally interesting, can cause maintenance and rockwork problems, as one struggles against rockwork to gain access to corners for cleaning, or one is unable to hide walls from view due to the curvature of the window. Given the bright lighting used in live coral tanks, curved windows can also exhibit internal reflection issues and cause undesirable distortion.

### LIFE SUPPORT SYSTEMS (LSS)

One of the most common design flaws seen in many aquariums is the inadequate amount of space allotted to life support systems, especially, lighting. All too often the tank size is maximized at the expense of space for LSS and lighting, necessitating the placement of LSS a fair distance from the display, and requiring aquarist contortions that Houdini would be proud of, to reach valves, meters, filter access ports and lighting fixtures. Clearance above exhibits should be great enough to allow easy access to light fixtures and to allow light fixtures to be raised and lowered as required for husbandry needs. Adequate space above the exhibit also allows gravity operated water motion devices to be used.

### EXHIBIT SIZE AND SHAPE

Coral exhibits are simply easier to aquascape, look more natural and function better if length and width are maximized. Although height (depth) is also important, the height should not exceed the width of the exhibit by a significant amount, the greater the width to height ratio, the larger the surface area available for coral growth, light penetration, gas exchange and aquascaping. A wide exhibit allows more space for coral growth, and reduces the shading of

corals at the bottom of the exhibit by those growing at the top. The bottom line here is to avoid at all costs, tall, narrow exhibits when dealing with keeping live corals; it just creates more problems than benefits.

Today's trend towards mega sized exhibits makes one wonder about the value gained by going to such dimensions. While large exhibits truly give one a sense of "being there", one can't help but feel that they also diminish the visitor's experience when it comes to truly experiencing what a coral is. After all, most coral polyps are only a few millimeters in size. From the distances corals are viewed in large exhibits, one is sometimes hard pressed to tell whether the corals are actually alive or artificial. Would an aquarium be better served with a smaller exhibit, where the visitor can get close to both the fish and corals, or with a large exhibit where the overall scene is of greater importance - something to think about perhaps.

### BACKGROUNDS

One of the most problematic areas to deal with in any exhibit are the back and side walls. One can have the most realistic looking aquascape covered with beautiful, thriving live corals, yet it can be spoiled by walls that are stained with coralline algae, algae filled scratches or paint flaking off in spots. While some feel that bare walls are fine, and they can look nice when the tank is first opened, in time scratches will occur in the finish, and coralline algae will begin to colonize it giving it a spotted appearance. If the purpose of a blue wall is to convey the water column, it is hard to maintain this when the finish is compromised. One often hears from design firms or architects that the finish will be fine and it is easy to maintain - don't believe it.

There are a few ways to deal with this problem. One is to have rockwork everywhere leaving no bare walls to worry about. This can work but it really does depend on the exhibit and what habitat it is conveying. Another option is to use removable backdrops. These are sheets of flexible material that can be found in a wide variety of colours and is often used for wall covering (see e.g. [www1](http://www1)). This material works fine for smaller exhibits but since it is limited in height, it becomes more problematic to use for larger exhibits. In this case, only portions of the wall can be left without rockwork so

that it is small enough to allow for the use of a backdrop. A backdrop can be easily removed for cleaning, and allows for a pristine viewing surface to help maintain the illusion of depth and a water column lying behind the rockwork.

Creative lighting can also be used to dim or hide back walls, for example by restricting the lighting to the forefront of the exhibit and leaving the rear and side walls unlit. This can work very well in large exhibits that have a lot of front to back depth available; this is the same technique used in large oceanariums for shark displays. For smaller displays, dioramas and backlit panels like those used in sea jelly exhibits are other options (see Delbeek and Sprung, 2005).

### CORAL PLACEMENT

Finally, once you have the aquascape installed and the system has been run for a while, it is time to add corals. When placing corals (and live rock for that matter) one needs to examine the growth form and shape of the piece, and then mount the coral in the exhibit in such a way as to preserve the coral's normal orientation as evidenced by its growth form. All too often nice looking coral exhibits will have corals placed in totally unnatural positions within the tank. This has been an ongoing problem with artificial coral placement in fish exhibits, and it is sometimes seen in live coral exhibits. A coral colony's shape is a reflection of its physical environment, namely light and water flow. For those not able to visit an actual coral reef, examine as many photos and videos of coral reefs as you can to gain an understanding of how corals grow in the wild under a variety of conditions.

### CONCLUSION

A live coral exhibit differs from most other exhibits in today's aquariums for a number of reasons. Their multi-taxa nature alone provides a unique opportunity to create ecological exhibits that mimic nature much more closely than the sterile marine fish exhibits that have been the prevalent standard in most aquariums for decades. As such, careful attention must be paid to exhibit design as this can have an impact on not only the overall visitor experience but

also the health of the inhabitants. The complex requirements of live coral exhibits also require specialized equipment, the proper location and use of which must be considered during any exhibit design process. Finally, it cannot be overemphasized enough that designers, architects, consultants and aquarists all need to work together from the outset to ensure that the exhibit design works for all concerned.

### SUGGESTED READINGS

Adey, H.A. and K. Loveland 1991. *Dynamic Aquaria: Building Living Ecosystems*, Third Edition. Academic Press, San Diego, CA, USA: 528 pp.

Baensch, H.A. and H. Debelius, 1995. Part I Seawater atlas (in German) Mergus Verlag, Melle, Germany.

Delbeek, J.C. and J. Sprung, 1994. *The Reef Aquarium: A Comprehensive Guide to the Identification and Care of Tropical Marine Invertebrates*, volume 1. Ricordea Publishing, Coconut Grove, FL, USA: 544 pp.

Delbeek, J.C. and J. Sprung, 1997. *The Reef Aquarium: A Comprehensive Guide to the Identification and Care of Tropical Marine Invertebrates*, volume 2. Ricordea Publishing, Coconut Grove, FL, USA: 546 pp.

Delbeek, J.C. and J. Sprung, 2005. *The Reef Aquarium: Science, Art and Technology*, volume 3. Ricordea Publishing, Coconut Grove, FL, USA: 680 pp.

Nilsen, A.J. and S. A. Fosså, 1996. *The Modern Coral Reef Aquarium*, volume 1. Birgit Schmettkamp Verlag, Bornheim, Germany: 368 pp.

Paletta, M.S. 2003. *Ultimate Marine Aquariums: Saltwater Dream Systems and How They Are Created*. TFH Publications, Neptune, NJ USA. 192 pp.

Senske, J. and M. Senske, 2006. *The Inspired Aquarium: Ideas and Instruction for Living with Aquariums*. Quary Books, Gloucester, MA, USA: 176pp.

Spotte, S. 1992. *Captive Seawaterfishes: Science and Technology*, John Wiley & Sons, New York, USA: 942 pp.

### INTERNET RESOURCES

www1. [www.korogard.com](http://www.korogard.com)

*Appendix 1. Check list of coral exhibit design considerations*

- Architects, exhibit designers and aquarists should work as a team at the outset.
- Coral husbandry consultants need to be brought in at the beginning of the exhibit design process, not at the end.
- Aquarist access must be considered when designing exhibits and LSS components.
- Avoid tall, narrow exhibits; they are very difficult to aquascape effectively and to maintain.
- Use nature as a guide when designing rockwork layout, avoid solid walls with little relief in shape or orientation.
- Visible edges should be concealed by rockwork either directly or by using line-of-sight techniques.
- No plumbing, water returns, airstones, ladders, window edges, etc. should be visible from the viewing panels.
- The use of backdrops can hide LSS components and provide a “clean” appearance to visible walls.
- Curved windows should be used sparingly and carefully considered with respect to their placement and maintenance.
- Corals should be placed in natural orientations with respect to the rockwork. Coral growth forms often indicate colony orientation requirements.